8.1 EXERCISES

PRACTICE

Convert the radian measure to degrees. See Example 1.

1. $\frac{5\pi}{4}$ **2.** $\frac{\pi}{180}$ **3.** $-\frac{3\pi}{8}$ **4.** $-\frac{7\pi}{6}$ **5.** $\frac{2\pi}{3}$

6. $\frac{7\pi}{20}$ **7.** $\frac{5\pi}{6}$ **8.** $\frac{11\pi}{10}$ **9.** $-\frac{9\pi}{4}$ **10.** $-\frac{5\pi}{3}$

Convert the degree measure to radians. See Example 1.

11. 47° **12.** 93° **13.** 132° **14.** 154° **15.** 148°

16. 120° **17.** 480° **18.** 520° **19.** 125° **20.** 90°

Convert each of the following angle measures as directed. See Example 1.

21. Express $\frac{3\pi}{2}$ in degrees.

22. Express $-\frac{9\pi}{4}$ in degrees.

23. Express 3π in degrees.

24. Express $\frac{\pi}{12}$ in degrees.

25. Express $-\frac{2\pi}{5}$ in degrees.

26. Express $\frac{2\pi}{3}$ in degrees.

27. Express 20° in radians.

28. Express 340° in radians.

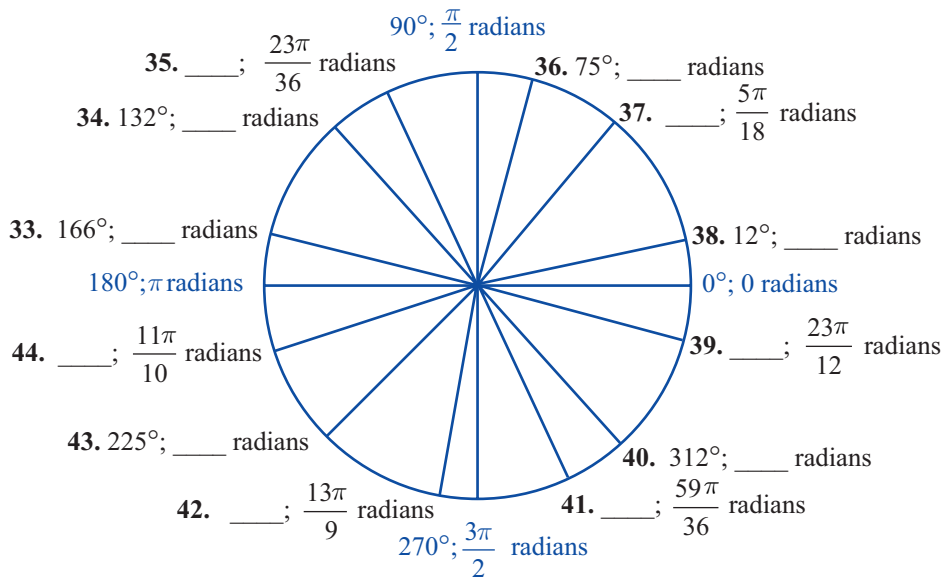
29. Express –144° in radians.

30. Express 66° in radians.

31. Express 30° in radians.

32. Express 180° in radians.

The unit circle shown below shows several angles in radians or degrees. Fill in the corresponding radian or degree measure for Exercises 33–44.



Use the information in each diagram to determine the radian measure of the indicated angle. See Example 2.

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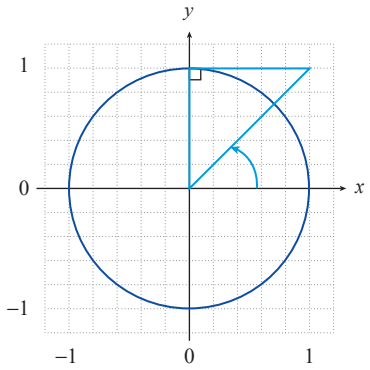

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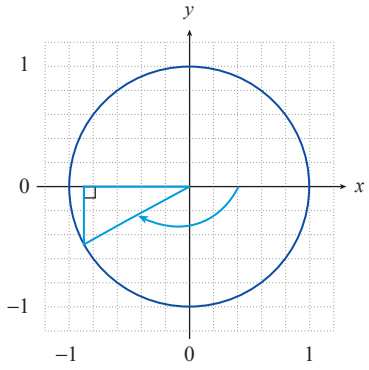

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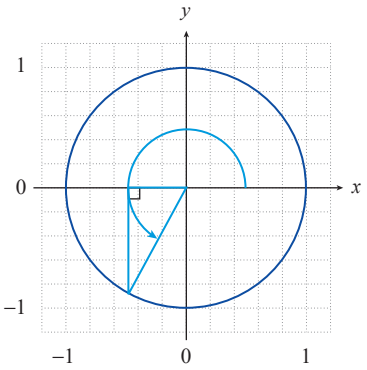

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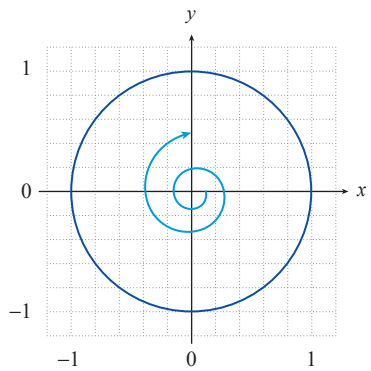

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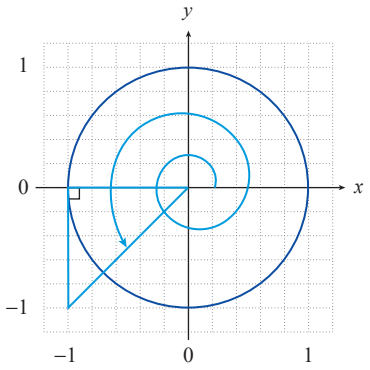

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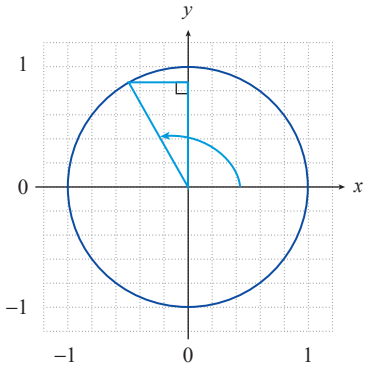


Sketch the indicated angles. See Example 2.

51. $\frac{5\pi}{2}$

52. $-60°$

53. $210°$

54. $-\frac{\pi}{3}$

55. $\frac{7\pi}{4}$

56. $120°$

Find the length of the arc subtended by the given central angle θ on a circle of radius r. Round your answers to two decimal places.

57. $r = 4$ in.; $\theta = 1$

58. $r = 9$ cm; $\theta = \frac{\pi}{2}$

59. $r = 15$ ft; $\theta = \frac{\pi}{4}$

60. $r = 80$ km; $\theta = 180°$

61. $r = 16.5$ m; $\theta = 30°$

62. $r = 7$ ft; $\theta = 90°$

Find the radian measure of the central angle θ given the radius r and the length s of the arc subtended by θ. Leave your answers in fraction form.

63. $r = 14$ ft; $s = 63$ ft

64. $r = 16$ in.; $s = 6$ in.

65. $r = 23.5$ dm; $s = 10.5$ dm

66. $r = 13$ cm; $s = 130$ cm

67. $r = 2$ km; $s = 22.5$ km

68. $r = 33$ ft; $s = 11$ ft

APPLICATIONS

Find the indicated arc length in each of the following problems. Round your answers to two decimal places. See Example 3.

69. Given a circle of radius 5 inches, find the length of the arc subtended by a central angle of 17° (**Hint:** Convert to radians first).

70. Given a circle of radius 22.5 cm, find the length of the arc subtended by a central angle of 3π.

71. Given a circle with a diameter of 6 feet, find the length of the arc subtended by a central angle of 68° (**Hint:** Convert to radians first).

72. Given a circle of radius 7 m, find the length of the arc subtended by a central angle of $\frac{7\pi}{8}$.

73. A fly walking around the edge of a circular table 6 feet in diameter subtends a central angle of 35°. What distance does the fly walk?

74. Assuming that Columbia, SC and Daytona Beach, FL have the same longitude (81° W), use a radius of 6370 km for Earth and the following to find the distance between the two cities.

City	Latitude
Columbia, SC	34° N
Daytona Beach, FL	29.25° N

75. Given that two cities on the equator are 100 miles apart and have the same latitude (that is, one is due west of the other), what is the difference in their longitudes? Use a value of 3960 miles for the radius of Earth.

76. Using a radius of 1.2 cm for the average eyeball, find the degree measure of the central angle formed to meet the edges of an iris (the colored portion of the eye) with an arc length of 9 mm.

77. Find the distance between Denver, CO and Roswell, NM which lie on the same longitude. The latitude of Denver is 39.75° N and the latitude of Roswell is 33.3° N. Use a radius of 3960 miles for Earth.

78. Find the distance between Atlanta, Georgia and Cincinnati, Ohio which lie on the same longitude. The latitude of Atlanta is 33.67° N and the latitude of Cincinnati is 39.17° N. Assume Earth's radius is 6370 km.

79. Find the distance between Greenwich, England and Valencia, Spain which lie on the same longitude. The latitude of Greenwich is 51.48° N and the latitude of Valencia is 39.47° N. Assume Earth's radius is 6370 km.

80. Find the distance between La Paz, Bolivia and Caracas, Venezuela which lie on the same longitude. The latitude of La Paz is 16.50° S and the latitude of Caracas is 10.52° N. Assume Earth's radius is 6370 km.

81. Find the distance between Bucharest, Romania and Johannesburg, South Africa which lie on the same longitude. The latitude of Bucharest is 44.43° N and the latitude of Johannesburg is 26.21° S. Assume Earth's radius is 6370 km.

The following problems ask you to determine the angular and/or linear speeds of various objects. Round your answers to two decimal places. See Example 4.

82. An industrial circular saw blade has a 10-inch radius and spins at 1000 rpm. Find **a.** the angular speed of a tooth of the blade in radians per minute and **b.** the linear speed of the tooth in feet per second.

83. Earth takes roughly 23 hours and 56 minutes to rotate once about its axis. Using a radius for Earth of 3960 miles, what is the linear speed in miles per hour (relative to the center of Earth) of a person standing on the equator? (Ignore, for the purposes of this problem, such motion as the rotation of Earth about the sun.)

84. A stationary exercise bike is ridden at a constant speed, causing the wheel to spin at a rate of 50 revolutions per minute. If a tack becomes lodged in the tire of radius 14 inches, find **a.** the angular speed of the tack in radians per minute and **b.** the linear speed of the tack in feet per minute.

85. A horse is tethered and urged to trot such that it completes a circular path every 5 seconds. If the rope which tethers it is 20 feet long, what is the linear speed of the horse in miles per hour?

86. The wheels of a certain bike are 28 inches in diameter. If the wheels are rotating at 210 revolutions per minute, how fast is the bicycle moving in miles per hour?

87. The floppy disk drive (FDD) was invented in 1967 to store information for computer users. The first floppy drive used an 8-inch disk and had a radius of 3.91 inches. The drive motor would spin at 300 rotations per minute (RPM).

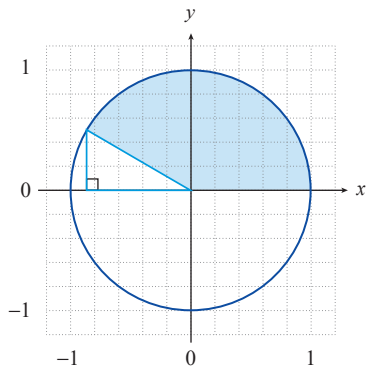
a. Find the angular speed of the 8-inch disk in radians per second.
b. Find the linear speed of a particular point on the circumference of the 8-inch disk in inches per second.

88. The 8-inch floppy disk drive evolved into a smaller 5.25-inch disk that was used in the personal computers (PC) in the early 1980s. The 5.25-inch disk had a radius of 2.53 in. The usual drive motor for the 5.25-inch disk would spin at 360 rotations per minute.

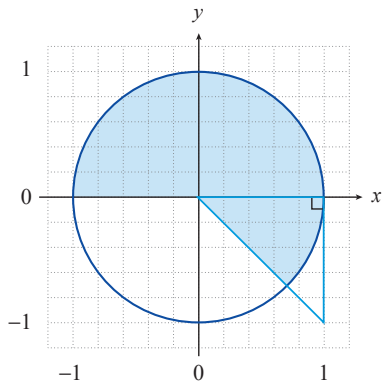
a. Find the angular speed of the 5.25-inch disk in radians per second.
b. Find the linear speed of a particular point on the circumference of the 5.25-inch disk in inches per second.

Exercises 89–100 ask you to calculate the area of a sector of a circle. Round your answers to two decimal places. See Example 5.

89. Find the area of the shaded portion of the circle.



90. Find the area of the shaded portion of the circle.



91. Find the area of the sector of a circle of radius 7 cm with a central angle of 70°.

92. Find the area of the sector of a circle of radius 3.5 ft with a central angle of 27°.

93. Find the area of the sector of a circle of radius 4 m with a central angle of $\frac{3\pi}{5}$.

94. Find the area of the sector of a circle of radius 16 in. with a central angle of 138°.

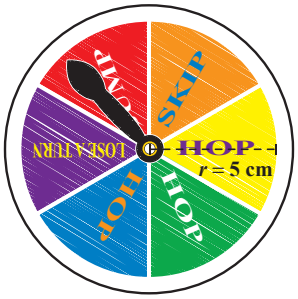
95. Find the area of the sector of a circle of radius 20 ft with a central angle of $\frac{\pi}{2}$.

96. Find the area of the sector of a circle of radius 19 km with a central angle of 5.31°.

97. A pie of radius 5 in. is cut into 8 equal pieces. What is the area of each piece?

98. The minute hand of a clock extends out to the edge of the clock's face, which is a circle of radius 2 in. What area does the minute hand sweep out between 9:05 and 9:25?

99. The circular spinner for a board game is divided into 6 equal wedges, each of a different color. If the radius is 5 cm, what area is encompassed by 2 wedges?



100. A lawn sprinkler throws water over a distance of 20 ft. If it rotates back and forth through an angle of 50°, what is the area of the region it waters?

101. Two gears are rotating to turn a conveyor belt. The smaller gear rotates 80° as the larger gear rotates 50°. If the larger gear has a radius of 18.7 in., what is the radius of the smaller gear?

102. Two water mills are on display at a local museum. The smaller water mill rotates counterclockwise and turns the larger water mill in a clockwise direction. If the smaller water mill has a radius of 5.23 ft and the larger water mill has a radius of 8.16 ft, what is the degree of rotation of the larger wheel when the smaller rotates 60°?